

# **Beam Instrumentation for the JUNO Detector Calibration System**

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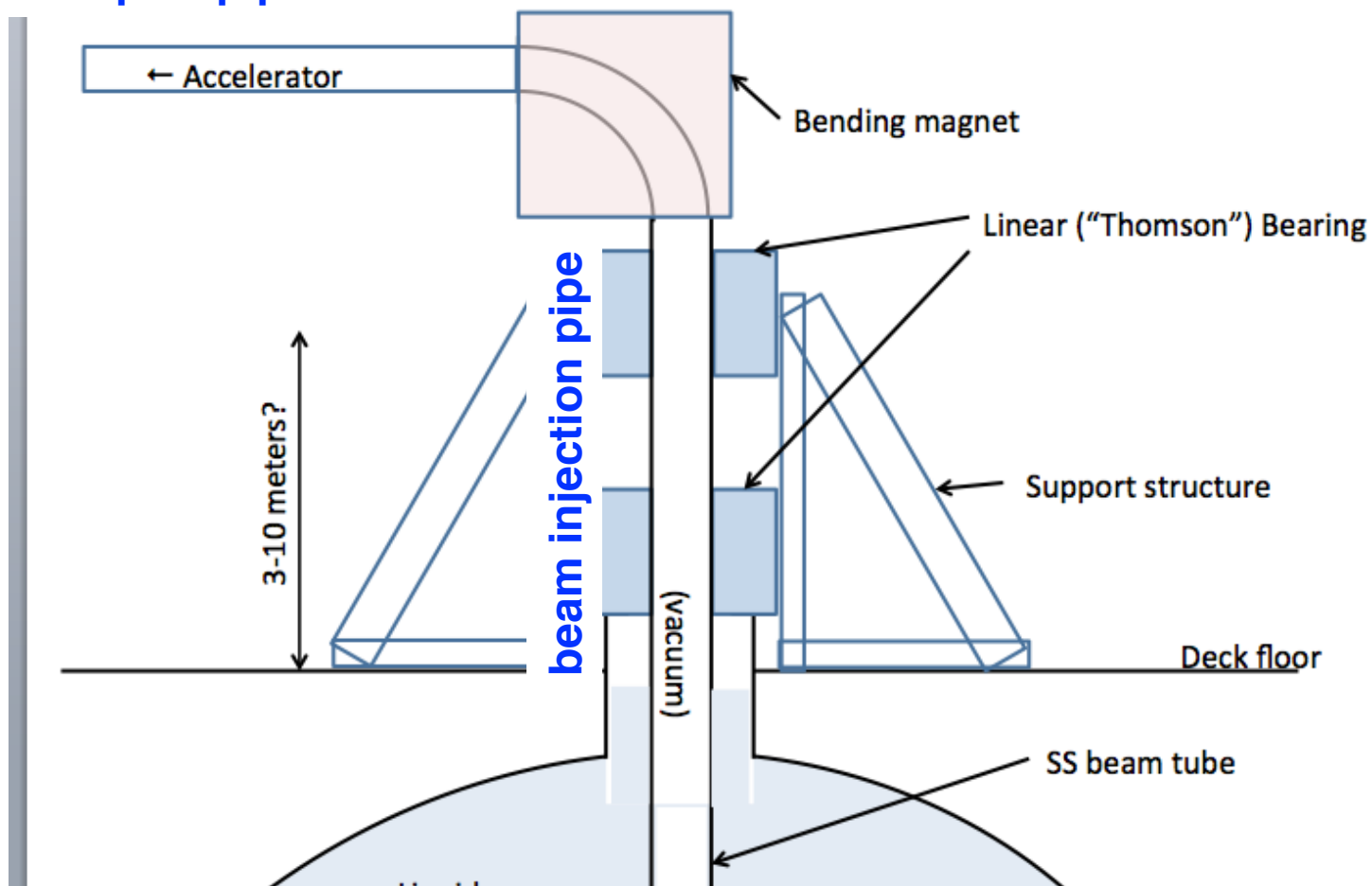
# Technical Considerations & Requirements

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- **Beam transport pipe**
  - monitor position of beam to tune and optimize transport
  - standard technology
  - can be moved in and out of beam path
  - cabling and readout outside beam pipe on deck above detector
- **Beam injection pipe**
  - custom-designed beam pipe without steering elements, possibly segmented beam pipe
  - all detectors, readout, and cables need to be contained within beam pipe
  - require detectors to be moveable out of beam
  - desire detectors to be moveable along beam pipe

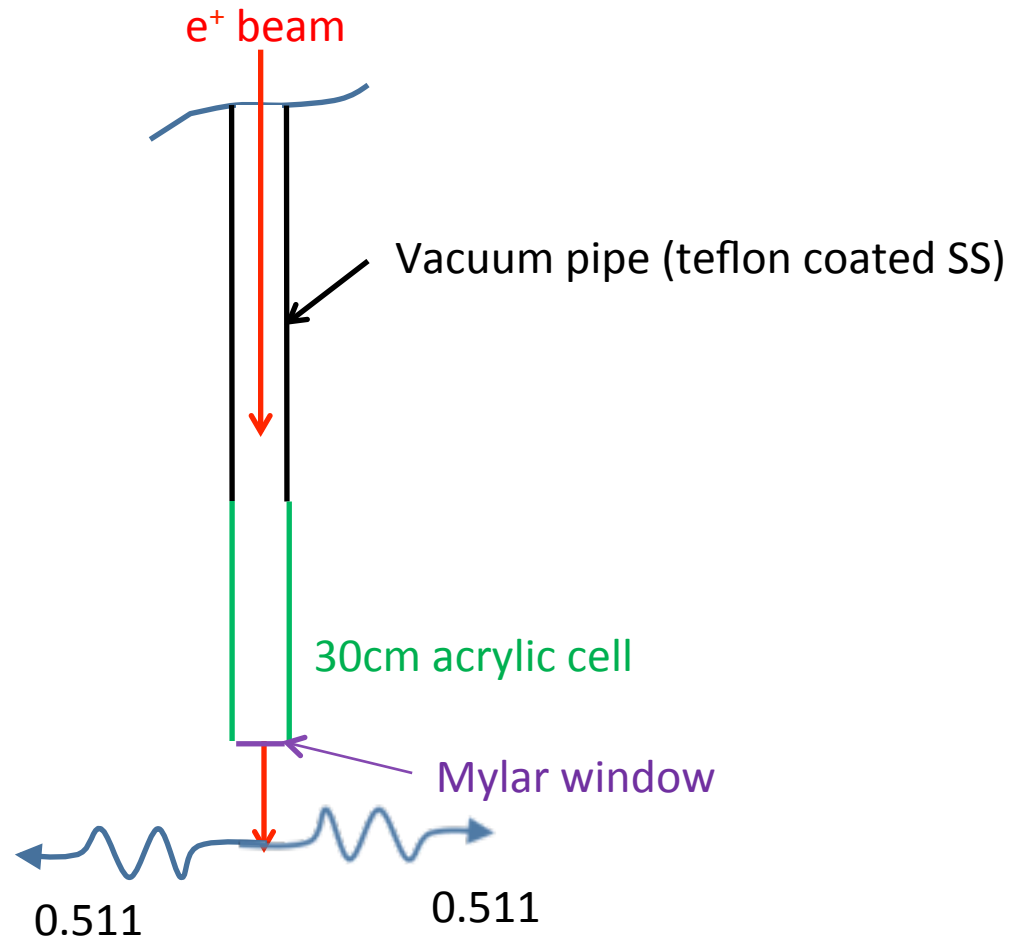
# Beam Transport & Injection Pipe

## beam transport pipe



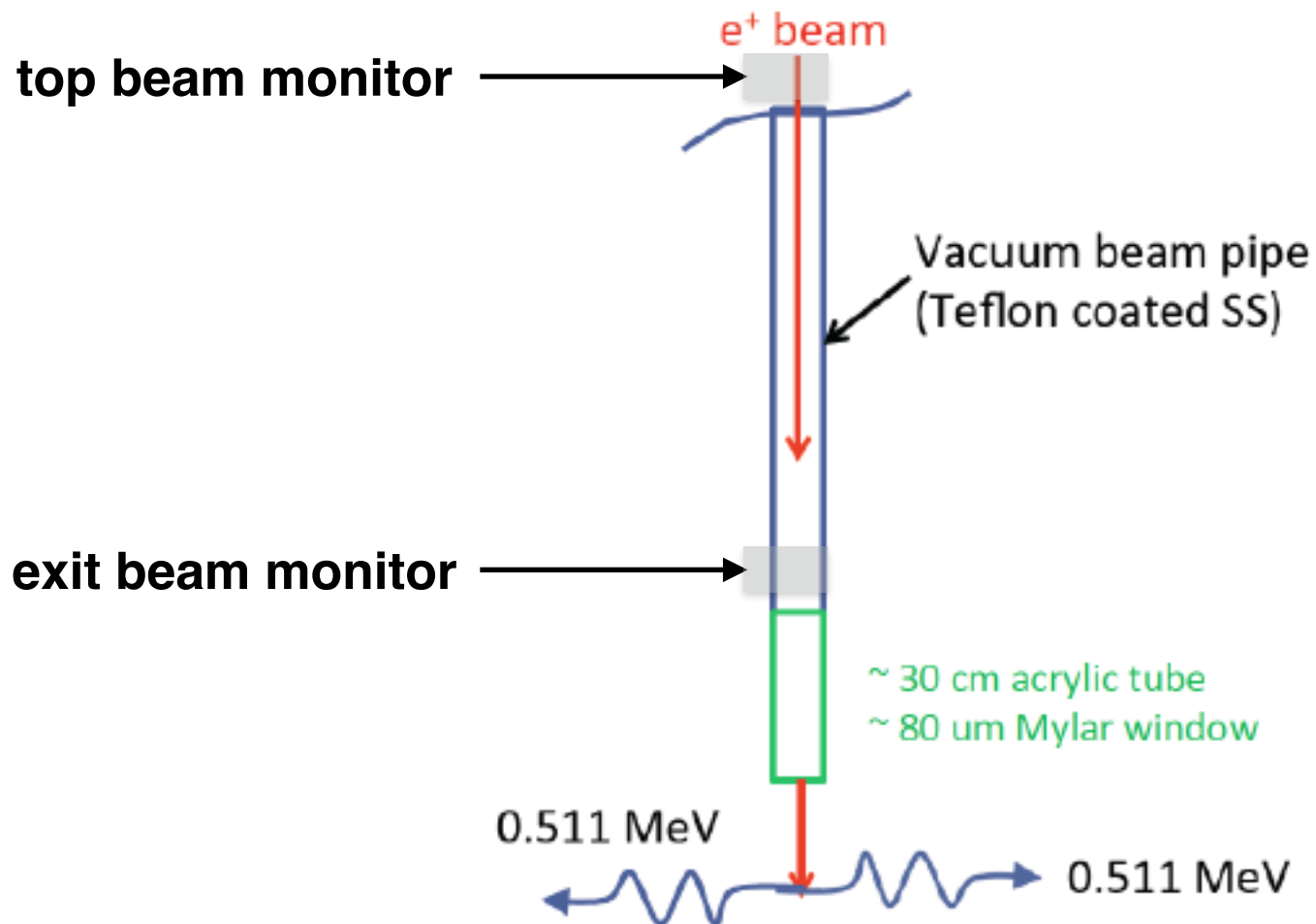
Ref: McKeown

# Injection Pipe



Ref: McKeown

# Beam Monitors in Injection Pipe



# Beam Transport Monitoring

## Ionization Strip Chambers

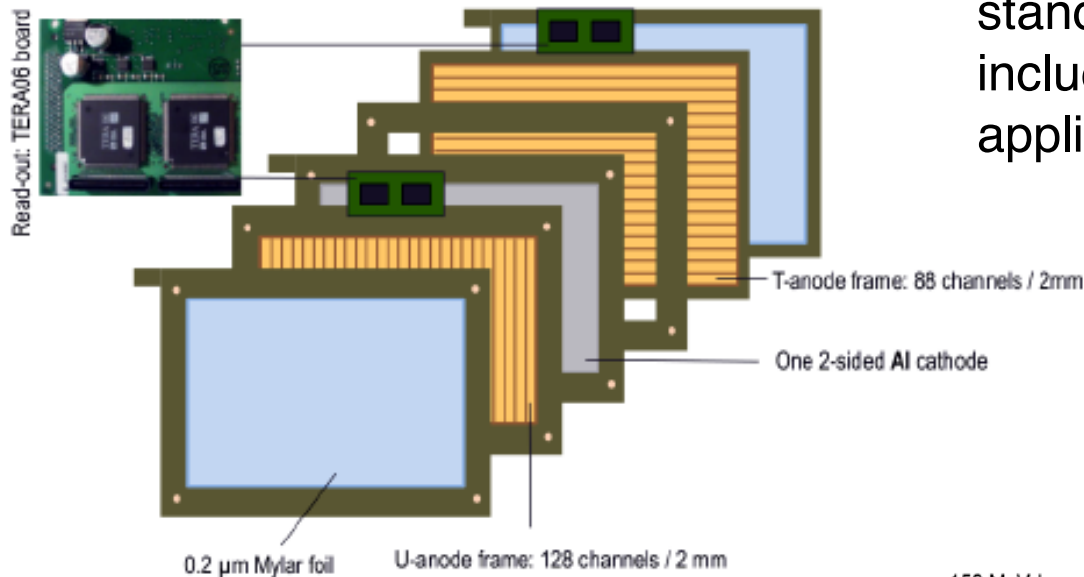
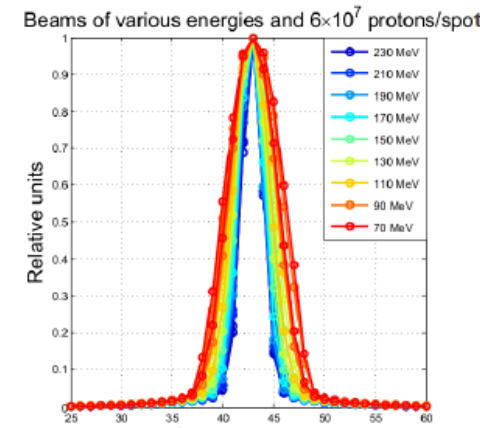
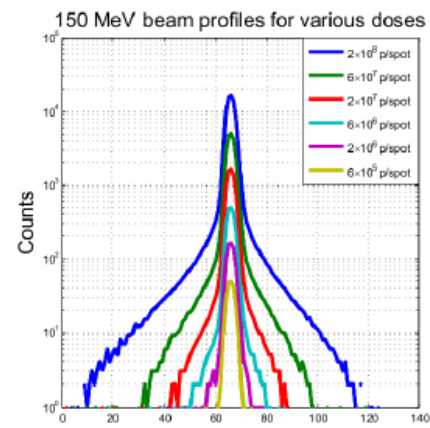


Figure 1. Schematic view of the ionization strip c

ionization strip chambers  
standard in many applications  
including industrial and medical  
applications



# Beam Injection Pipe

## Segmented Silicon Detectors

multi-pixel silicon p-ion-diode array  
for detection of beta electrons

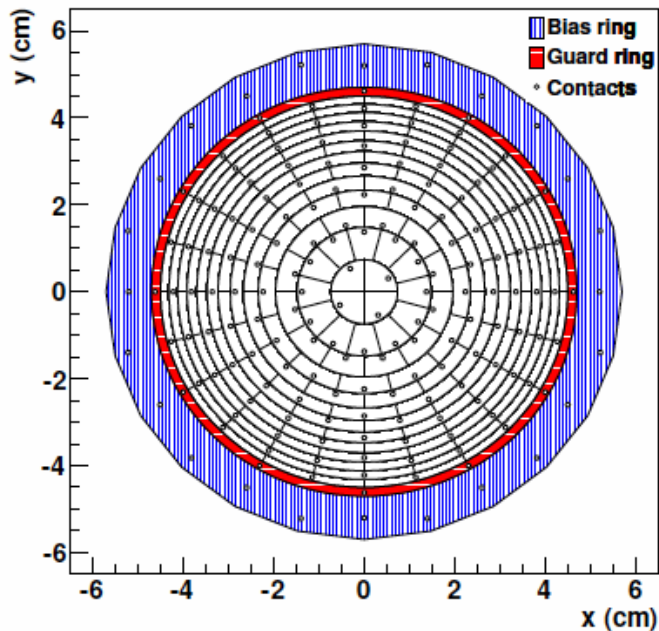


Figure 7: FPD dartboard pixel pattern, surrounded by a guard ring and bias ring. Open circles show the points where electrical contacts are made.

example: KATRIN focal plane detector  
manufactured by Canberra Belgium

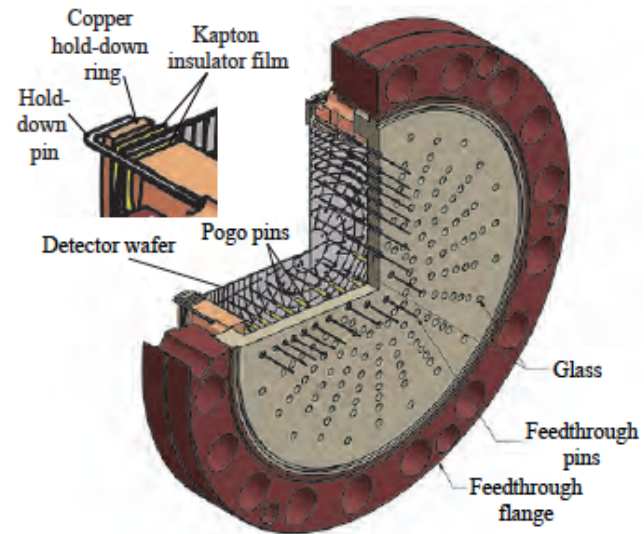


Figure 8: Mounted detector wafer (back) with spring-loaded pogo pins and feedthrough flange. The inset is a close-up view of the detector compression scheme.

Ref: 1404.2925

# R&D Required

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- identify monitor positions
  - required positions along transport pipe
  - desired optimum positions along injection pipe
- identify and adapt strip ionization chambers for transport pipe
- determine if injection pipe can be continuous or needs to be segmented
- determine required segmentation of Si detector in injection pipe (simulations and geometry)
- determine if detector needs to be movable along injection pipe
- develop customized readout package that can be integrated in beam pipe
- develop mechanical mechanism for “rotating” detector in and out of beam inside injection pipe
- test Si detector with electron gun